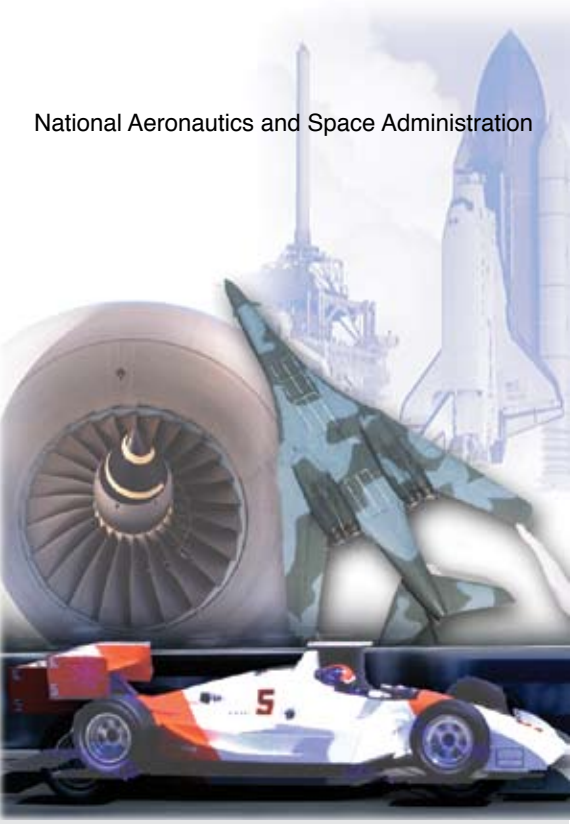
National Aeronautics and Space Administration



NASA Offers Advanced Polymers for Application in Industry

Advanced Polymer technologies developed by NASA Langley Research Center are available for creating high-performance parts, coatings, films, and adhesives.

NASA Langley Research Center (LaRC) has a long history of research and development of high-performance materials for NASA's aeronautics and aerospace missions. NASA has invested in the development of various polymer chemistries and processing improvements. All of these materials have excellent toughness and solvent resistance. NASA has numerous families of advanced polymers patents available for license. Consider the benefits these technologies offer your applications.

Some of Langley's advanced polymer families available for licensing are described below. Table 1 presents the applications appropriate to each family and the level of benefit the NASA technology offers.

LaRC-IA—"Improved adhesive" offers processes and chemistries to lower the cost of high-performance polyimide adhesives, coatings, and films. NASA's intellectual property (IP) for this family is tailorable across various chemistries and applications.

LaRC-SI—"Soluble imide" is a unique copolymer that is soluble in the imide form and thus enables solvent coating and layered buildup.

LaRC-PETI—Includes both processes and chemistries to improve the processability of polyimide parts made of high-temperature matrix resins that can be used for very long-life applications.

LaRC-BP—"Branched polymers" enable improved processability and higher-temperature applications; these chemistries afford excellent melt flow at 15 psi for ultra-high-temperature applications.

LaRC-RP—Polyimide thermoset family exhibiting operating temperatures from -150˚F to 625˚F with ability to withstand spikes to 1500˚F.

Table 1: Technology Comparison

Applications		IA	SI	PETI	BP	RP
ADHESIVE	hot melt	+++	+	+++	+++	+
	self-adhesive	+	+++			+
	solution coating	+	+++	+	+	+++
COATINGS	abrasion-resistant	+++	+++	+++	+++	+++
	conductive[1]	+	+	+	+	+
	electrostatic			+++	+++	+++
	moisture-resistant	+++	+++	+++	+++	+++
	optical	+	+			+
	powder processing	+	+	+++	+++	+++
	radiation shielding	+++	+++	+++	+++	+++
COMPOSITES	complex parts			+++	+++	+++
	simple parts	+++	+++	+++	+++	+++
	matrix resin	+		+++	+++	+++
	processing—VARTM			+++	+	+
FILMS	adhesive	+++	+++			
	large area	+++	+++			
	other	+++	+++	+		
FOAM	various forms	+++	+++	+	+	+

[1] When filled with conductor

+++ Best Choice + Applicable

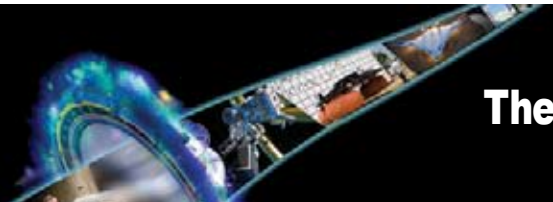


Table 2 offers greater insights into properties and applications.

Table 2: Specific Properties					
	LaRC-IA	LaRC-SI	LaRC-PETI	LaRC-BP	LaRC-RP
Glass Transition Temperature	230-250°C	250°C	250-280°C	200-325°C	230-393°C
Physical Chemistry	thermoplastic with no crosslinking results in extreme flexibility, and reprocessability		thermosets that by varying molecular weight between reactive end groups results in tailorable cross-link density—amount of crosslinking controls use temperature		thermoset that can be cross-linked to varied degrees with several backbone structures
Modulus	High		Tailorable		High
Processing	melt/compression moldable	can be solution cast and sprayed as either a polyamic acid or polyimide because remains soluble in imidized form; can be layered; melt processable via injection, extrusion, and compression molding	low-pressure processing (15psi), long-term melt stability (hours at 300°C), start with low molecular weight monomers but finished part has infinite molecular weight, can be powder form for VARTM processing (post melt) with no volatiles		liquid form for prepreg of carbon, glass, or quartz fabric; powder for compression molding
Various Properties	3000 psi adhesive strength hot melt or solution coating	excellent adhesion to copper, aluminum, titanium, and ceramics; solution and melt forms	able to make complex shapes, Ti-Ti, composite bonding	reactive adhesive system, able to make very complex shapes	low moisture absorption, good thermal oxidative stability and resistance to microcracking
Coatings	from solution	abrasion-resistant/ protective—on Nomex cloth for conveyor belts in drying ovens, EMI and radiation shielding, optical coatings, conductive coatings	can be sprayed, painted, or dipped with melt processing		from solution, can be painted or dipped—melt processing of partially reacted foam is possible
Aeronautics/ Aerospace	matrix resin, adhesive, or molding with self-adhesive potential with resistance heating	specialty applications	high-temperature parts, including engines, supersonic fuselage, structural heat shields, etc.		
Auto/Trucks/ Farming Equipment		moisture-resistant materials	"under the hood" in high-temperature environments		
Electronics		multi-layer printed circuit boards with increased shear strength and durability at elevated temperatures	complete parts, including connectors and other moldings		high-temp circuit boards
Products Using NASA Technology	specialty high-temperature foam—e.g., shipboard insulation	piezoelectric actuators, insulation on implantable medical electrical leads	aircraft, including military applications		randomes, engine vanes, exhaust ducts, high-temp bearings
Representative US Patents	5,478,916 5,502,127	5,741,883 6,048,959	5,664,022 6,133,401 6,288,209	5,965,687 6,191,252	6,777,525 5,171,822

For More Information

If your company is interested in licensing or joint development opportunities associated with this technology, or if you would like additional information on partnering with NASA, please contact:

The Technology Gateway

National Aeronautics and Space Administration

Langley Research Center
Mail Stop 218
Hampton, VA 23681
757.864.1178
LARC-DL-technologygateway@mail.nasa.gov
technologygateway.nasa.gov

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